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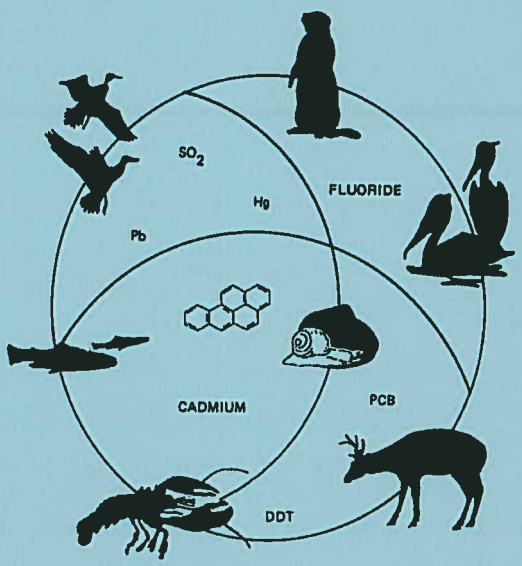
U.S. FISH AND WILDLIFE SERVICE
REGION 6

CONTAMINANTS PROGRAM

1996 LEAD SHOT STUDY OF UPLAND HABITAT ON NORTH DAKOTA'S FEDERAL TRUST RESOURCE LAND



U.S. FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
1500 EAST CAPITOL AVENUE
BISMARCK, NORTH DAKOTA 58501

1998

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE
REGION 6

ENVIRONMENTAL CONTAMINANTS PROGRAM
1996 LEAD SHOT STUDY OF UPLAND HABITAT ON NORTH DAKOTA'S FEDERAL TRUST RESOURCE LAND

North Dakota Final Report Preparations
Project ID: 96-6-6N32 & 97-6-6N32

by

Environmental Contaminants Program

for
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Bismarck, North Dakota
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ABSTRACT

In 1996, the U.S. Fish and Wildlife Service (Service) collected field data to determine the extent of lead shot deposition on upland areas of North Dakota's Federal trust resource lands. An electronic metal detector was used to sample 21 tracts of land totaling 6,415 hectares (ha) in 11 Wetland Management Districts. This study was designed to identify upland areas where lead shot deposition might potentially affect bird morbidity and mortality. No lead shot pellets were found in any of the study areas. One steel shot pellet was found on the Lake Alice National Wildlife Refuge tract.

INTRODUCTION

Lead poisoning of birds, linked to lead shot in the environment, has been a problem in this country since the turn of the century. By 1983, approximately 2,721,554 kg of lead shot was being deposited annually by waterfowl hunters in the United States (Feierabend 1983). In North Dakota, over 90,000 kg of lead shot was annually being scattered over lakes, potholes, agricultural fields, and uplands by bird hunting activities (Bihrle and Johnson 1987). Numerous studies addressing the effects of lead poisoning on waterfowl and the abundance of lead shot in wetland environments have been conducted (Feierabend 1983). Studies by Anderson (1984) and Kendall et al. (1996) on non-waterfowl bird species have relatively recently examined the problem of lead shot deposition on upland areas and lead poisoning of birds that utilize upland habitats. An ecological risk assessment focusing on upland game birds and raptors (Kendall et al. 1996) estimated that 5.6 to 9.2 million kg of lead were introduced annually into terrestrial environments through the harvest of mourning doves in the United States. Studies have shown that heavily hunted areas such as hunting preserves and State game management lands may have soil lead shot densities in excess of 800,000 pellets/hectare (Kendall et al. 1996).

The majority of U.S. Fish and Wildlife Service (Service) trust resource lands in North Dakota are open to public hunting of waterfowl and upland game birds. The Service has the responsibility to manage these lands for the benefit of wildlife and the American public. The use of lead shot for waterfowl hunting was banned nationwide beginning with the 1991-92 hunting season (U.S. Fish and Wildlife Service 1991). Although the ban on lead shot use for waterfowl hunting reduced the amount of lead being deposited in the environment, lead shot is still being used for hunting upland game birds on Federal trust lands. The Service is proposing a ban on the use of lead shot on trust resource lands nationwide in 1998 that would require non-toxic shot for any type of bird hunting on those lands administered by the Service.

Lead shot pellets exposed on the ground or lying just beneath the soil surface may be ingested by birds that use upland areas while foraging for food or grit (Anderson 1986). Game birds that use upland habitats in North Dakota include pheasant (Phasianus colchicus), sharp-tailed grouse (Tympanuchus phasianellus), grey partridge (Perdix perdix), mourning dove (Zenaida macroura), Canada goose (Branta canadensis), snow goose (Anser caerulescens) and mallard (Anas platyrhynchos). Some passerine species (mostly grainivorus birds) may also be at risk from lead shot lying on the ground. Lead shot ingested by birds is broken down through mechanical (grinding in the gizzard) and chemical (stomach acid) processes to form lead salts that enter the birds

bloodstream. Lead is a cumulative metabolic poison affecting a large number of biological functions including survival, reproduction, growth and development, and behavior (Kendall et al. 1996). The ingestion of lead shot may result in a slow death by lead poisoning within 17-21 days (Bihrle and Johnson 1987). Additionally, birds that are poisoned by lead and scavenged by others, especially raptors, represent a significant threat via secondary poisoning to those animals consuming a lead poisoned bird. It is also possible for lead poisoned birds to contribute to disease outbreaks such as botulism (Bihrle and Johnson 1987).

Knowledge of lead shot deposition on different upland areas can reveal the potential for avian lead poisoning, dictating appropriate management actions such as soil manipulation (plowing, discing, or removal of topsoil) (Fredrickson et al., 1977) or excluding birds from the area to reduce the likelihood of lead shot ingestion during foraging. Lead shot deposition information is also useful in determining if lead poisoned birds acquired lead pellets in the area where the affected birds were found. An investigation into lead poisoned Canada geese on a small pond in southeastern Colorado (Szymczak and Adrian 1978) and another in South Dakota (personal communication Larson 1997) determined that the birds were not killed by lead pellets picked up from the bottom of the pond where the geese were found, but rather from heavily hunted upland areas adjacent to the pond.

This study was initiated to collect data to determine if spent lead shot pellets are available to birds on upland habitat areas of North Dakota's Service trust resource lands, and if lead shot pellets are present, do they pose a health risk to avian species. The focus of this study was to identify any problem areas, on a statewide basis, rather than quantify lead shot in specific areas. Therefore, we designed the study to cover a large area with randomly scattered sample plots to increase the probability of areas with lead shot concentrations intersecting one or more of the areas chosen to be sampled. The study was biased toward Service trust resource lands known to receive upland hunting pressure (personal communication, Wetland District Managers).

STUDY AREA

In North Dakota, the Service administers 85,716 ha of fee-owned National Wildlife Refuge (NWR) land and 100,876 ha of fee-owned Waterfowl Production Area (WPA) land. WPAs ranging in size from less than a hectare to thousands of hectares are trust resource lands managed by the Service to enhance waterfowl production values. NWRs and WPAs are managed in eleven Wetland Management District offices across the State (Figure 1). Some NWRs and most WPAs are open to public hunting of upland game under Federal and State regulations.

Habitat types found on North Dakota's trust resource lands include lake, river, wetland, cropland, native prairie, tame grass (dense nesting cover), shrub, and deciduous forest. In our study, we sampled all but the lake, river, and wetland habitats. The vegetation component of our sample sites was highly variable with an average of 22.8% native grass, 35.8% tame grass, 28.5% forbs, 9.9% woody (shrubs and trees), 1.5% marsh, 1.4% cropland, and 0.1% bare ground. There were 21 areas sampled (Figure 1), two areas in each of ten WMDs and one in the Devils Lake WMD for a total area of 6,415 hectares. The size of upland areas sampled ranged from the smallest, Nickeson WPA at 13 hectares, to the largest, Lake Alice NWR at 1,302 hectares.

METHODS

Two tracts of Service property in each of 11 WMDs statewide were selected for sampling (Figure 1). These tracts were identified by their respective District Managers as the District's two tracts which receive the most upland hunting pressure. Sample sites were randomly chosen from upland areas so each habitat type within the uplands had an equal chance of being sampled. The number of samples for each tract of Service land was based on the total number of upland hectares. The initial number of sample sites (based on the size of the smallest tract to be sampled) was set at three upland sample sites per 12 hectares, and for every quadrupling in area, the number of sample sites was doubled (e.g., 48 hectares equals six sample sites). The number of sample sites for each individual tract was adjusted to fit the total hectares of uplands located on that tract. A sample size of 255 sample sites with 765 sample plots covering 6,415 hectares of uplands was chosen to insure the study (spanning the entire State of North Dakota) could be completed in one field season. Field work for the study commenced on July 22, 1996, and concluded on September 4, 1996.

Sample sites were randomly selected using a grid system and a random number table. A battery operated electronic metal detector (the Falcon MD 10S/P) was used to locate and recover any lead shot that might be present in each of three sample plots per sample site. Before beginning our fieldwork, the electronic metal detector was tested to insure it would be sensitive enough to detect spent lead shot pellets to a depth of 5.0 cm below the soil surface. Two test trials were conducted to check the operation and sensitivity of the electronic metal detector. The first was conducted with one person seeding six, 930.25 cm^2 test plots with a known number of #6 lead shot pellets at a range of depths (from lying on the ground surface to a maximum depth of 5.0 cm). The metal detector was then used by another individual, who did not know the location or number of pellets planted in the test plot, to retrieve any lead pellets found in the plot. All of the pellets in each of the six test plots were accounted for and readily recovered. The second trial was conducted at a local gun club trap and skeet range, a location known to have a high concentration of spent lead shot pellets (Kendall et al. 1996). Two sample sites, with three sample plots each, were randomly chosen and sampled. As was expected, numerous lead shot pellets were detected and recovered from each of the six gun club sample plots. These two test trials demonstrated a high level of confidence in the ability to detect and recover lead shot pellets in the field using the electronic metal detector.

Sampling protocol was developed for processing each sample site to ensure consistency. An ATV was used to drive to the sample site marked on a map.

After reaching the sample site, a line was walked 25 paces to the left of the ATV and the sample square (a device constructed of 1.27 cm dia. plastic PVC pipe, 30.5 cm by 30.5 cm square) was thrown forward into the air. The individual sample plot was where the square came to rest. This procedure was repeated moving to the right of the ATV and also to the front of the ATV. Hand held grass shears were used to remove the vegetation from each sample plot. The metal detector was turned on and checked for proper operation and sensitivity using a test card (a note card with three #6 lead shot pellets attached). The metal detector probe was moved through the sample plot in a continuous criss-cross motion, left-to-right and then top-to-bottom until the entire area within the sample square had been covered twice. The operation and sensitivity of the metal detector was rechecked, using the test card, before turning the unit off and moving on to the next sample plot. This operation was repeated for each of the three individual sample plots at every sample site. Sample results, type of vegetation at the site, sample site description, and other pertinent information were recorded in a field notebook before moving to the next sample site. Control samples (the top 5.0 cm of soil in the first sample plot at every tenth sample site) were collected, after the sample plot was checked in the field with the electronic metal detector, to verify field results through more intensive scrutiny of the sample in a laboratory setting. After the soil for the control sample was collected, the disturbed area was reseeded with native grass.

If the metal detector indicated the presence of metal in the sample plot, a garden trowel and a small pair of tweezers were used to find and recover the metal object. The soil was removed in the area indicated by the metal detector and placed on a non-metallic surface. The soil was separated into smaller and smaller pieces, each checked with the metal detector, until the metallic object was found. If the object was discovered to be a shot pellet, a magnet was used to determine if it was steel or lead. Any shot pellets found were placed in a small glass vial labeled with the sample name and number.

RESULTS AND DISCUSSIONS

A total of 22 tracts were selected for sampling, but only 21 tracts were sampled for the presence of lead shot pellets (the Pelican Lake tract was under water and therefore was not sampled). There were 255 sample sites, 765 individual sample plots, and 23 control samples collected. No lead shot pellets were found on any of the 255 sample sites selected for this study (Table 1), but one steel shot pellet was recovered from a sample plot on Lake Alice NWR, Ramsey County. These results were unexpected, because the Federal lands targeted for this study were those that the respective WMD managers identified as areas that received significant upland bird hunting pressure.

Assumptions were made in the design of this study, such as: lead shot pellets deposited during previous hunting seasons would be present the following year, and a random sample of all upland habitat types would include areas where lead shot was deposited by upland bird hunters. The results of this study indicate these assumptions may not be accurate. Lead shot pellets move, over time, from the ground surface down into the soil profile through natural weathering processes, soil manipulation, and/or by being covered by soil or detritus particles (Kendall et al. 1996, White and Stendell 1977). Therefore, to increase the likelihood of finding lead shot, the study might have commenced immediately after closure of the previous hunting season. Upland game birds are not typically found equally across all upland habitat types. The preferred habitats of upland game birds varies with the species and season of the year. The random sample selection could have been stratified to focus on those upland habitats, most likely to hold populations of upland game birds during the fall hunting season. Shotgunning for upland game birds by its nature does not concentrate spent shotgun pellets in one area, compared to waterfowl hunting over decoys. Upland bird hunters move over large areas of possible habitat in search of game and shoot at birds in many different situations, seldom shooting more than once from the same place, distance, or angle. This results in spent lead shot pellets being spread over large areas and difficulty in detecting them. To adjust for this factor, a larger sample size would be more effective in detecting the presence of lead shot pellets.

Because no lead shot pellets were found on any of the study sample plots, a statistical analysis was not done.

The use of a hand-held electronic metal detector appears to be an acceptable method for determining the presence of spent lead shot pellets in the soil. The results of our pre-study tests of the electronic metal detector support our confidence in the detector's capability to discern lead shot pellets if they are present. Furthermore, the fact that no lead shot pellets were found

in the laboratory analysis of the control samples, after testing negative for lead shot in the field, provides evidence that lead shot pellets were not overlooked using the electronic metal detector. Previous lead shot studies have used radiography to detect spent lead shot pellets in soil samples (Anderson 1986). For studies such as ours, that are attempting to sample a number of areas on a statewide basis, the radiography method has some drawbacks, such as: removal of top soil, weight of the soil samples collected, the need to transport all soil samples back to the lab for processing, and the necessity for large non-portable x-ray equipment to detect the lead shot pellets in the processed samples.

The electronic metal detector allowed all sample plots to be checked for the presence of spent lead shot pellets in the field, leaving the soil in place, except for the first plot of every tenth sample site which was collected as a control. Control samples (the top 5 cm of soil from the sample plot) were collected, labeled, and transported back to the lab for a more rigorous examination to determine if any lead shot pellets were overlooked while in the field. No lead shot pellets were found in any of the control samples.

To determine the abundance of spent shotgun pellets in the soil of a 14 hectare field in Illinois, managed for dove hunting, Anderson (1986) collected 100 samples. It would be expected that certain locales (i.e., a field managed for dove hunting or other habitat features like food plots) may well contain areas with concentrations of lead pellets at or near the surface. Our study, however, was not designed to determine abundance, but to detect the presence of spent lead shot pellets.

Our conclusion, based on the information gathered in this study, is that lead shot pellets on upland areas of Service trust resource lands in North Dakota and the subsequent availability to birds is not a common occurrence. If a more precise determination of lead shot deposition for specific upland areas is required, more intensive survey methods may be needed.

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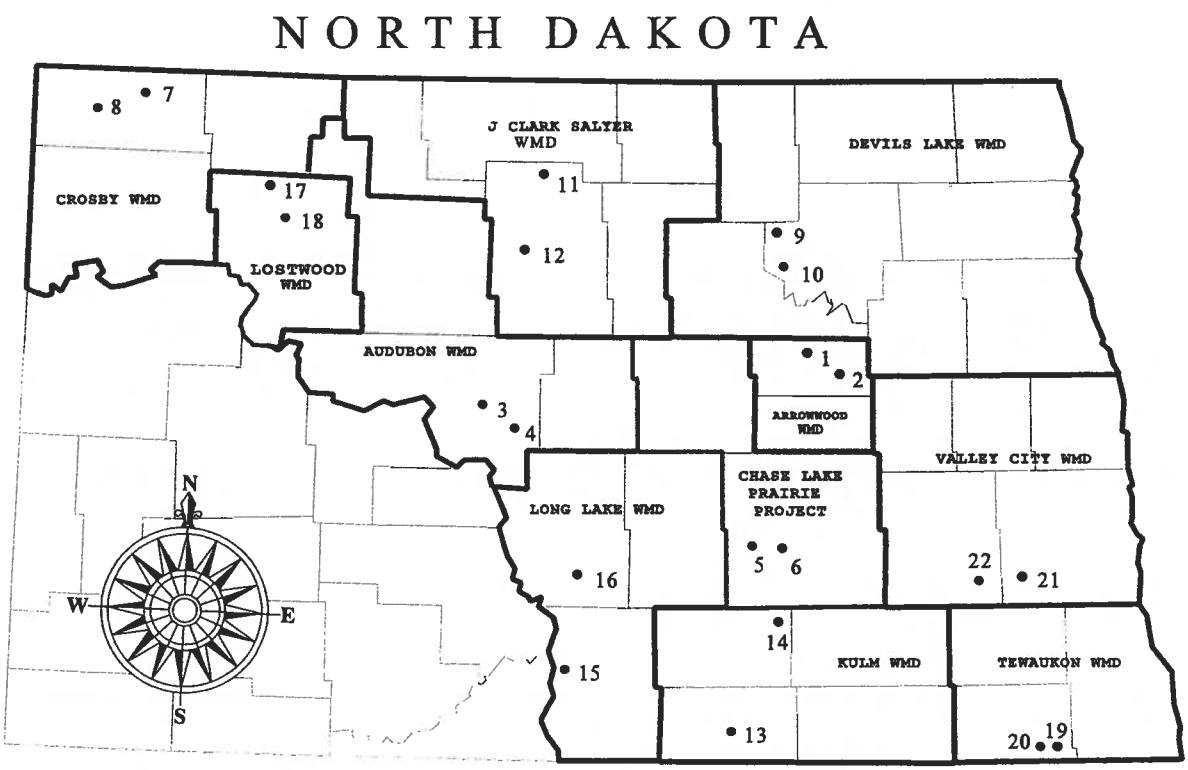
Table 1 - Wetland Management Districts (WMD) and tracts selected for study

	Upland Hectares	# Sample Sites	# of Plots Sampled	Shot pellets Found
Arrowwood WMD				
Wood WPA	37	5	15	0
Wallace WPA	236	13	39	0
Audubon WMD				
Coal Coulee WPA	102	8	24	0
Koenig WPA	1068	27	81	0
Chase Lake Prairie Project				
Kutz WPA	86	8	24	0
Woodworth WPA	893	25	75	0
Crosby WMD				
Wigness, Cy WPA	102	7	21	0
Carlson WPA	25	4	12	0
Devil's Lake WMD				
Lake Alice WPA	1302	29	87	0*
Pelican Lake WPA	204	12	. . .	ND†
J. Clark Salyer WMD				
J. Clark Salyer NWR	259	13	39	0
Mike's Peak WPA	215	12	36	0
Kulm WMD				
Denning WPA	187	12	36	0
Larson WPA	213	12	36	0
Long Lake WMD				
Schiermeister WPA	215	12	36	0
Victor WPA	62	6	18	0
Lostwood WMD				
Coteou WPA	971	26	78	0
Halverson WPA	90	8	24	0
Tewaukon WMD				
Krause WPA	59	6	18	0
Nickeson GDU	13	3	9	0
Valley City WMD				
Alice WPA	221	13	39	0
Fingal WPA	55	6	18	0
Totals	6415	267	765	0

* One steel shotgun pellet found (approximate size - # 2 shot).

† No data - Pelican Lake WPA not sampled due to flooded sample sites.

Figure 1 - Location of Tracts Selected for Lead Shot Study



1. Wood WPA
2. Wallace WPA
3. Coal Coulee WPA
4. Koenig WPA
5. Kutz WPA
6. Woodworth WPA
7. Carlson WPA
8. Wigness, Cy WPA
9. Lake Alice NWR
10. Pelican Lake WPA
11. J. Clark Salyer NWR
12. Mike's Peak WPA
13. Denning WPA
14. Larson WPA
15. Schiermeister WPA
16. Victor WPA
17. Coteou WPA
18. Halverson WPA
19. Krause WPA
20. Nickeson WPA
21. Alice WPA
22. Fingal WPA